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ABSTRACT

Based on the findings of a content analysis of representative literature on educational technology, this report examines trends in educational technology from October 1, 1994 through September 30, 1995. Eight trends for 1995 are identified and discussed: (1) computers are pervasive in schools and higher education institutions and virtually every student in a formal education setting has access to a computer; (2) networking is one of the fastest growing applications of technology in education; (3) access to television resources in the school is almost universal; (4) advocacy for the use of educational technology has increased among policy groups; (5) educational technology is increasingly available in home and community settings; (6) new delivery systems for educational technology applications have grown in geometric proportions; (7) there is new insistence that teachers must become technologically literate; and (8) educational technology is perceived as a major vehicle in the movement toward education reform. An analysis of trends from 1988-1995 and an explanation of the methodology used in this study conclude the monograph. Copies of worksheets, definitions, and additional data are appended. (Contains 46 references.) (AEF)

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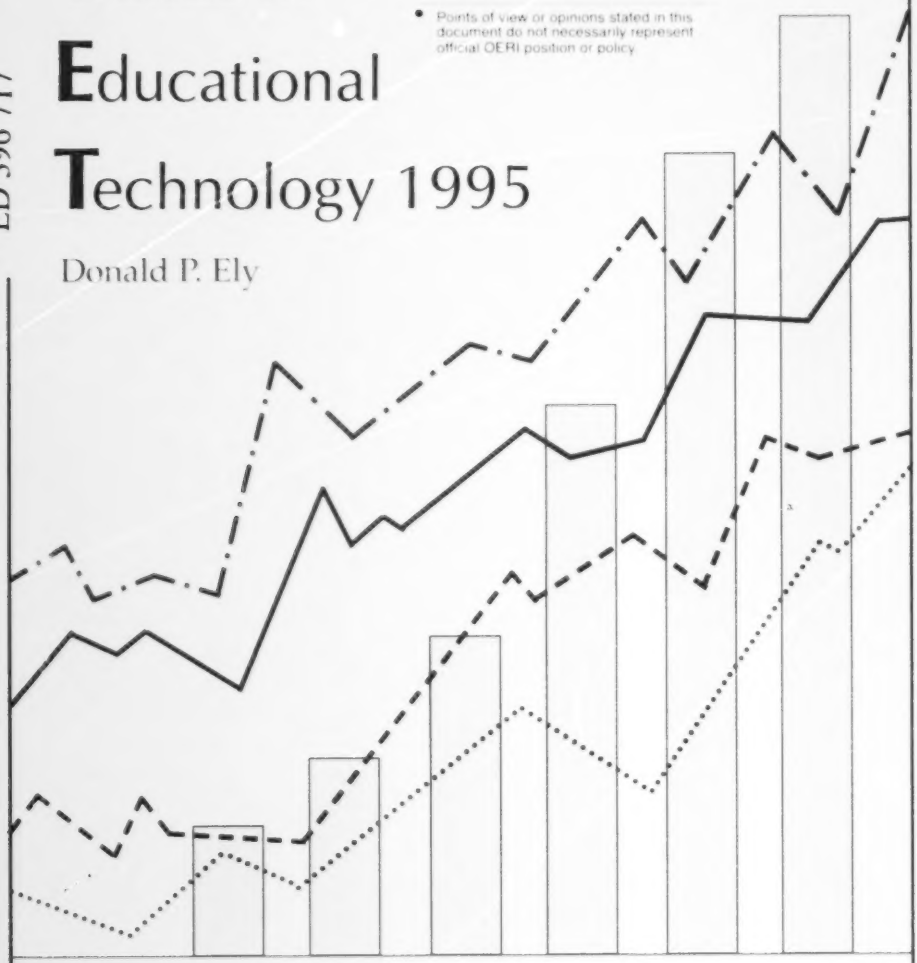
Trends in Educational Technology 1995

Donald P. Ely



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Trends in Educational Technology 1995

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with

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May 1996

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The methodology section was written by three reviewers who participated in the content analysis: Paul E. Blair, Paula Lichvar, and Deborah Tyksinski. Melissa Martinez was a reviewer for this work. The authors and reviewer are graduate students in Instructional Design, Development and Evaluation at Syracuse University.

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Eric Plotnick, Editor in Chief

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Preface

This is the fourth monograph in the *Trends in Educational Technology* series. It covers the period from October 1, 1994 through September 30, 1995. Previous editions covered the years 1988, 1989, and 1991. This monograph incorporates data and trends from the previous editions and adds current information and analysis. Because this process has continued for seven years, a broader overview of trends can be provided using baseline data from the earlier studies. The trends can also be determined with greater confidence because they are viewed from a longitudinal perspective. Because it builds upon the earlier studies, this edition is more than just a study of 1994-95 trends.

The methodology for content analysis has been consistent in all the studies. The same journals, conferences, and universities producing doctoral dissertations were examined, along with the ERIC educational technology database input during the year. The same recording instruments and terminology definitions were used. A team of four graduate students worked with the author to review nearly 1,200 documents or citations. Additional policy literature, not part of the content analysis, was used to provide confirmation of the trends, to offer examples, and to translate some of the quantitative data into qualitative statements. The final determination and elaboration of the trends is the sole responsibility of the author. The manuscript was reviewed by professional educational technologists who recommended changes and additions.

The introduction to this edition is an updated version of the one found in the 1992 monograph. New data and appropriate new commentary are added to what appears in the previous studies. The trends are listed separately with supporting data, subjective commentaries, and references. The methodology section was written by three of the reviewers who participated in the content analysis: Paul E. Blair, Paula Lichvar and Deborah Tyksinski. The fourth reviewer, Melissa Martinez, did not participate in writing the methodology section. The commitment of these budding professionals to the task at hand and their persistence in performing the content analysis made the preparation of this manuscript much easier for the author.

Trends are rarely direct reflections of the truth; at best they are indicators of direction. Trends do not necessarily predict the future; they are more likely to report where we are. This attempt to identify the trends in educational technology in 1995, and to relate them to earlier trend studies, provides a platform for discussion of the issues facing the field, and a launching pad for future studies. This is a moment in history; a photograph of "what is" that can serve a short-term purpose in a field that is still relatively new and growing.

Syracuse, New York **Donald P. Ely**

March, 1996

Introduction

There are many ways in which trends may be identified: expert opinion, panels of specialists, or informed observation. This study uses content analysis as the primary vehicle for determining trends. It is based on earlier works of Naisbitt (1982) and his inspiration (Janowitz, 1976). The basic premise of these works is that current trends can best be determined by analyzing what people are saying publicly, through newspapers and magazines. Naisbitt used actual counts of linear inches in key periodicals to determine trends. This study, and the three that have preceded it, uses the same basic procedure: the identification of emerging topics in key publications over a period of one year. It is possible to determine trends by considering what people are saying publicly about matters within the field. There may be other ways to determine trends, such as counting sales of products, or discovering where professionals are being placed and analyzing what they are doing. We have chosen to use the literature of the field as the best comprehensive coverage of current thinking and events in the field. We have carefully reviewed a selected body of literature using a team of educational technology specialists to determine the status of the field as it exists today and to indicate where it might be headed in the future.

A consistent methodology has been used from year to year. It follows the general principles of content analysis, and uses a group of trained coders to make independent judgments about the literature being reviewed. Group discussion about findings has to reach high interrater reliability for each item before it is placed in an agreed upon category. When items fall into more than one category, the dominant content or emphasis determines placement into the most appropriate category. The recording units have remained constant (for the most part) each year. Additional subcategories are used as needed to reach a higher level of specificity.

When reading this study, one must be careful not to extrapolate the trends too far into the future. It is often tempting to use trends as predictors of future developments. Actually, trends are more like indicators that foreshadow the future. They are statements of current happenings in the field and, as such, must be considered tentative movements that will bear watching as time goes on. They are useful because they represent current

public statements that have been systematically analyzed and reported.

Literature Sources

To maintain consistency from year to year, the same sources of information were used in the 1995 study as were used in the 1988, 1989, and 1991 studies, with a few exceptions. To aid in the selection of sources, the Moore and Braden (1988) report, was used. This source reported the people, publications, and institutions that were identified by a survey of personnel in the field. The highest ranking journals and the dissertations produced by the universities that ranked the highest served as two major sources of literature. Additional sources of data were papers given at major national and international conferences, and input to the ERIC database in the field of educational technology. Conference presentations are visible ways to present new ideas and findings to colleagues, and therefore contribute to the trends. The ERIC system solicits unpublished materials such as reports, evaluations, studies, and papers for review and, following evaluative criteria, selects the best for inclusion in the database. The ERIC Clearinghouse on Information & Technology is responsible for the field of educational technology, and documents selected from that source are likely to represent current developments in the field. The sources are presented in Figure 1.

Figure 1. Content Sources

Journals

British Journal of Educational Technology (United Kingdom)
Innovations in Education and Training International (United Kingdom) (New title replacing *Educational and Training Technology International*)
Educational Technology
Educational Technology Research and Development
TechTrends

Dissertation Sources

Arizona State University
Florida State University
Indiana University
Syracuse University

University of Southern California

Conferences

Association for Educational Communications and Technology
Educational Technology International Conference (United Kingdom)
National Society for Performance and Instruction

ERIC Input

All documents in the field of educational technology entered into the ERIC system. All journals were published between October 1994 and September 1995. The conferences were held in 1995. The ERIC documents were entered into the system between October 1, 1994 and September 30, 1995.

Leading Topics

Four coders analyzed nearly 1,200 articles, documents, and other sources, and produced a list of content analysis categories that were most frequently presented in the literature. That list, together with the 1988, 1989, and 1991 numbers, is presented in Table 1.

Table 1. Rank Order of Content Analysis Categories

	1995	1991	1989	1988
Instructional processes	1	1	1	1
Technological developments	2	3	2	3
Management	3	2	3	4
Research/theory	4	4	8	8
The field	5	5	4	5
Services	6	6	5	6
Personnel	7	8	6	2
Society and culture	8	7	7	7

Each of the above categories has a series of subtopics (or recording units) that were used to identify content more specifically. The recording units are defined in Appendix C. Themes were identified from the subtopics (recording units). The themes were later translated into trends as additional information sources were consulted. Table 2 shows the top 13 themes for 1988, 1989, 1991 and 1995.

The recording units offered a first indication of trends. Further analysis of each category and subcategory revealed sharper distinctions. At that point, the key literature was added to the mix. Key literature included the policy papers, reports, and statistical data for each category published during the dates of the study. This literature came from professional associations representing large numbers of people within and outside the field of educational technology, state and national governmental agencies that speak with some authority, organizations of policy makers, and business/industry sources. This information, together with the content of the literature reviewed, was studied by the author, who using personal observations (probably with some personal biases), drafted the trends and sent them to the individuals who reviewed and categorized the literature for further discussion. A copy of the final draft was sent for review to recognized professionals in the field and to a reviewer in the Office of Educational Research and Improvement of the U.S. Department of Education. Changes were made when compelling arguments to do so were presented.

Table 2. Themes of Top 13 Recording Units

	1995	1991	1989	1988
Design and development*	318	203	259	448
Research/theory	118	91	38	51
Evaluation**	103	144	99	97
Computer-related	93	65	90	82
Interactive learning***	68	41	83	29
Distance education	67	88	81	61
Implementation	62	146	98	24

Telecommunications	59	59	71	14
Status	47	80	95	61
Society and culture	37	45	71	72
Curriculum support	17	51	79	25
Artificial intelligence/ Expert systems	8	35	46	31
Logistics	4	3	32	43
Others	204	265	387	228
TOTAL	**1205**	**1316**	**1529**	**1266**

* Includes message design, product development, learner characteristics.
** Includes process evaluation, product evaluation, formative evaluation, cost/effectiveness evaluation.
*** Includes multimedia and hypermedia.

Concerns about Previous Studies

When past editions of the *Trends and Issues* publications were read and critiqued, four concerns were expressed, and they were addressed before the 1995 version was prepared. First, whether content analysis is effective for large bodies of text; second, the validity and reliability of coding; third, the selection of the documents reviewed; and fourth, the translation of quantitative content data into descriptive trends.

Content Analysis of Large Bodies of Data

Conventional content analysis looks at words and phrases in an effort to identify and extract substantive meanings. The approach followed herein uses complete journal articles, doctoral dissertation abstracts, conference program descriptions, and ERIC document input. Weber (1990) says:

> Large portions of text, such as paragraphs and complete texts, usually are more difficult to code as a unit than

> smaller portions, such as words and phrases, because large units typically contain more information and a greater diversity of topics. Hence they are more likely to present coders with conflicting cues. (p. 16)

The findings of this study must be tempered by Weber's caution. He points out that "There is no simple *right* way to do content analysis. Instead, investigators must judge what methods are most appropriate for their substantive problems" (p . 13). Analyzing the periodical and document literature for a specified period of time still seems to be a useful procedure for identifying the general trends or emphases that come from the literature of that period. Much of the value comes from the consistency of recording thematic units that have been used over the past eight years.

The Validity and Reliability of Coding

The concern here is the stability, reproducibility and accuracy of the coding process (Krippendorff, 1980, pp. 130-154). Weber says, "Classification by multiple human coders permits the quantitative assessment of achieved reliability" (Weber 1990, p. 15). Each year, graduate students in educational technology were trained as coders. Definitions of categories were given, together with practice items from each document type. The author provided consistency in reviewing by serving as an additional coder each year. The criterion level for intercoder reliability in 1995 was .66; that is, two of the three coders had to agree upon a category for placement of each item.

Content Selection

Journals, conference programs, doctoral dissertations, and ERIC documents account for a broad range of literature generated by the field each year. Because the content appearing in the literature during any given year is essentially what professionals in the field are saying, one can argue strongly that the content units counted from that literature provide reasonable representation of the topics or themes that are emerging. One must be careful not to use these topics as *projections*, since they essentially represent what has already happened.

When examining the selection of journals, conferences, and

universities used in the study, one may ask, Why *these* and not others? The choice was based on the survey by Moore and Braden (1988) that reported the most prestigious journals and university programs. Beyond this criterion was another that eliminated journals or conferences that were devoted to a specific medium, e.g., computers in education. If articles about computing were found in the general literature, they were counted. However, selection of a journal or conference devoted entirely to a subfield within educational technology would skew the findings toward one medium.

Translation of Data into Trends

This is a subjective step and probably the most difficult to defend, since it ultimately relies on the judgment of one person. The number of articles, conference papers, dissertations, or ERIC documents, by category, reports the volumes of information about specific topics. These numbers form the basis for identifying the most frequent topics. The topics are the bases for selecting relevant documents in the policy literature that tend to confirm the topics identified. Policy literature includes statements, reports, papers, and other official publications of professional organizations, government agencies, and influential bodies such as foundations. For each of the leading trends, the policy literature is searched for statements to support the dominant trends. For example, in the past, the study team used publications of the Office of Technology Assessment of the U.S. Congress, the National Governors' Association publications about education, publications of the U.S. Department of Education's Office of Educational Research and Improvement (OERI), and publications of the various educational laboratories and research and development centers funded by OERI. Public statements and reports of the National Education Association and the American Federation of Teachers are used along with the publications of the Association for Educational Communications and Technology. Quantitative data from Quality Education Data and Market Data Retrieval provide consistent, reliable trend information on hardware and software. When the dominant themes from the primary literature sources are verified by policy statements from responsible organizations, trends are confirmed, and provide a reasonable rationale for reporting.

Context

This publication should answer the question, "Where is educational technology headed?" Technology does not move apart from the society in which it exists. Information and communication technologies are used in the home and in the workplace at all levels—local, state, regional, national and international. To separate technologies from their context is to highlight products alone, rather than to highlight their uses and impact. Therefore, much of the discussion in this monograph involves the total fabric of technology in society, as opposed to technology as an entity in itself. Technology is often referred to as a "tool" that incorporates the "media" of communication. The hardware and systems that carry information are often the primary focus, and little attention is paid to the audience, purpose, and consequences of their use. Design, development, evaluation and diffusion are lost to the overpowering influence of hardware and software. As the trends are reviewed, the hardware and software appear to dominate. It should be remembered that quantitative information reveals *extent* of use but does not reveal *quality* of use and *impact* on learners. Trend statements attempt to blend both quantitative and qualitative information by providing *indicators* of use. It is quite clear that educational technology is used frequently in the school and, increasingly, in the home. In the school, college or university, the individual teacher or professor is the single most important factor influencing appropriate implementation of media and technology for learning. That key individual is usually part of a system which, in turn, is connected to a larger unit—a state department of education or a university. National programs and initiatives are somewhat remote. International efforts seem even more distant.

Since the last study of trends and issues, there have been major national and international efforts to explore and promote the use of educational technology in schools. One of the major outcomes of those efforts is linkage between schools and other entities. This was not evident in the earlier studies. *Networking* is being used as the codeword for the many connections that are being made—most of them new. Networking by definition is the linkage made between and among people held together by a common theme or connection. Networking uses both new and existing systems that permit "real time," "live," interaction between individuals and groups: e.g. telephone, FAX, e-mail, computers, cable and satellite television, as well as face-to-face

and traditional correspondence approaches. Other systems store information for use at a chosen time: e.g. videotape recordings, videodiscs, CD-ROM discs, "floppy" discs and audio cassettes. It is easy to be enthusiastic about these new media (and they dominate the literature) but voices of concern about cost, equity of access, skills required, and purpose, are heard still, and will have to be heeded.

Networks exist within the school; within the school system; within the region; within the state; and among the states. Networks exist between schools and business; schools and government agencies (state and federal); schools and universities; schools and public libraries; schools and professional associations; schools and broadcasting sources; and schools and home. There appears to be a movement to create networks where none exist, and to connect networks that already exist. The dramatic increase in the use of the Internet is the best example of global networking.

As all these contexts impinge upon educational technology, one must remember that the trends which follow are more *internal* to the field, than external to the settings in which they happen to reside. The literature reviewed is authored by people inside the field, and the intended audience is largely people inside the field. They are often practitioner-advocates who have agendas to promote educational technology, and who use publications and conferences to do so.

At the same time, there appear to be strong calls by groups outside education, e.g., state governors, business and industry executives, and newspaper education writers to integrate technology in education. The target of both educational technologists and influential critics seems to be the mainline schools—the "establishment" that tends to perpetuate the status quo. Until there is an openness to use technology among educators in general, calls for technology in the schools will be unheeded, or accepted only in marginal ways.

This study focuses primarily on K-12 schools in the United States. Some information speaks to higher and adult education. Information from other technologically advanced nations is referred to when appropriate.

It should be noted that many trends in the field of educational technology may be found outside the education settings

featured in this study. New professionals graduating from the many graduate programs in the field are finding places in business and industrial training environments. There is another body of literature, not covered in this study, that reflects the many new developments in non-school settings. That fact is, in itself, a trend.

In Summary

Fully developed trends do not flow from the literature. Using a content analysis procedure that goes beyond the conventional word and phrase approach, general themes in the annual literature of educational technology are identified, counted and then verified by the policy literature. The translation from quantitative summaries to qualitative trend statements is mostly subjective.

Trend 1

Computers are pervasive in schools and higher education institutions. Virtually every student in a formal education setting has access to a computer.

The number of computers in schools has grown over the seven years the trends have been followed. In 1988-89, the student/computer ratio was 22:1; in 1995 it was 12:1 (Hayes and Bybee, 1995). Quality Education Data (1995a) has monitored the students/computer ratio since 1983 when it was 125:1. While numbers alone cannot determine the nature, extent and quality of use, they are indicators of availability. Access is the first step to use.

Ninety-nine percent (99%) of all elementary and middle schools in the United States have computers. The brands of computers differ in K-12 schools. In all schools where computers are used for instructional purposes, brand names differ. Eighty-six percent (86%) of schools use Apple (including Apple IIGS), 40% use IBM, 37% use Macintosh and 20% use other DOS units (Quality Education Data [QED], 1995a). More than a third of all computers used in schools are Apple IIs—a line that was discontinued in 1990. Schools do not tend to upgrade computers. They seem to be treated as textbooks—used until they are worn out. Obsolescence does not seem to penetrate K-12 schools as it does universities. There are no specific figures available for computer availability or use in post-secondary institutions.

In 1994-95, the total computer use in K-12 schools (100%) was divided among four major brands: Apple II (46%); IBM (24%); Macintosh (15%); and other MS-DOS (8%). [Note: the numbers in the previous paragraph represent total numbers of computers available; some schools have several brands.] Apple IIs have decreased from 63% in 1988-89 and IBM computers have increased from 12%. In 1988-89, Macintosh represented only 1% of the use, and other MS-DOS units 2% (QED, 1995b). The downward trend of the Apple IIs continues, as does the upward trend of the Macintosh and IBM.

In school districts, personnel most likely to have computers are instructional technology specialists, special education

teachers, and curriculum supervisors (QED, 1995a). Primary locations for computer use in K-12 schools are in computer laboratories and library media centers, although there are modestly increasing numbers in classrooms. A 1995 survey of technology use in schools reported that 85% of teachers and media coordinators used computers during the 1994-95 school year (Malarkey-Taylor Associates, 1995). None of the figures above include administrative use of computers in schools. There do not appear to be any current studies about ways in which computers are used for instruction. By inference it appears that computer "literacy" is a major use closely followed by word processing, spreadsheets, and network communication.

The pervasiveness of computers in schools, and the continuing advocacy for their use by many educators, equipment manufacturers, parents, and the community in general create a positive image of the computer's role in schools. However, there is some contrary evidence that brings into question the role and use of computers in schools. The Children's Partnership published *America's Children and the Information Superhighway: Skills for the Future* in 1995. There are some disturbing statistics:

- 80% of all school computers are considered to be obsolete according to the U.S. Department of Commerce's Information Infrastructure Task Force.
- The top 20% of schools, i.e., those with the highest ratio of computers to students, have 9 times as many computers as schools in the bottom 20%.
- 27-39% of all students report that computers are frequently unavailable at school.
- American students rank behind Austria, Germany, and The Netherlands in practical computer knowledge.

Post-secondary statistics are more difficult to obtain. Since 1989, Kenneth C. Green has conducted an annual survey of computer use based on the responses of about 600 higher education administrators. In the 1995 edition (Green, 1995b) he reports that 24% of classes were being held in computer-equipped classrooms, up 15.8% from 1994. Green's interpretation of the growth is that the use of technology for teaching is spreading beyond the computer enthusiasts to mainstream professors who are beginning to use computers in their teaching. Green believes that information technology has "emerged" as a permanent and respected part of the higher

education experience.

In a comparison of courses using technology in 1994 and 1995, Green found that e-mail increased from 8% to 20%; computer simulations from 9% to 15%; presentation handouts from 15% to 25%; use of commercial courseware from 12% to 18%; multimedia from less than 5% to 9%; and CD-ROM materials from 6% to 15.4% (Green, 1995).

There is a continuing concern about the costs of technology according to Green's report. Most institutions spent one-time budget allocations to purchase hardware and software, and only 22% of the institutions have a plan for replacing old computers with new models. About 20% of the institutions reported that they were cutting back on technology expenditures, and about the same number said they were cutting back on campuswide information technology services.

In an attempt to finance new and continuing expenditures, about 33% of the institutions are passing on technology costs to academic departments, and more than 50% were either charging computing fees to students, or contemplating such fees. Some colleges and universities are exploring the aquisition of less expensive equipment (Green, 1995).

Trend 2

Networking is one of the fastest growing applications of technology in education.

It is becoming increasingly difficult to separate educational technology from the milieu in which it exists. The rapid development of networked communications in business, government, and the military has spilled over to the home and school markets. The key word associated with much of the networking is "Internet." A 1995 study (Swisher, 1995) concludes that about 37 million people in the U.S. and Canada have access to the Internet—about 11% of the total population over the age of 16. Internet availability includes work settings, home, through friends, or via a commercial online service. The report goes on to say that about 31% of Internet users sign on everyday. More than two-thirds of the users sign on from their office. They spend an average of 5 hours and 28 minutes a week online. Another study estimated that commercial online services jumped from 5 million users to 12 million during the winter of 1994-95 (*Times Mirror Center for the People and the Press*, 1995).

The literature reviewed for this monograph reflects the broader society. There were more articles, conference programs, and ERIC papers about networking than in any of the three previous studies. Several journals and newspapers have established regular columns dealing with networking. States seem to be leading the way in establishing networks. Quality Education Data (1995c) has conducted studies of state networks for education since 1990. Very little activity was reported until 1993 when 29 states provided limited access to the Internet, primarily for e-mail, using a simple text-based menu. In 1995, 37 states offered more elaborate access, and 13 more states reported network planning in process. World Wide Web (WWW) access is available to educators in 33 states. Other Internet features currently available include: e-mail (37 states); FTP (34 states); Telnet (34 states); and Gopher (34 states).

The largest professional organization of teachers, the National Education Association, recognized the potential of networking in one of their 1995 resolutions:

The Association supports the development of a user-

> friendly infrastructure which can accommodate a decentralized approach to program and product development so that the interaction among educators, students, researchers, and those outside the educational community can occur. The infrastructure should be operated under voluntary standards that promote interoperability and that support user collaboration. Adequate measures to protect the security of resources on the network should be put in place. Further, comprehensive directories of information resources and navigation systems should be developed and maintained (*NEA Today*, 1995, p.36).

Further evidence of growth in networking is seen in the number of modems acquired by schools. Computers with modems provide access to networks. In the 1994-95 school year, modems existed in 29% of elementary schools, 39% of the middle/junior high schools, and 51% of senior high schools (QED, 1995b). This is an increase from 1991-1992 when 11% of elementary schools, 20% of middle/junior high schools, and 30% of high schools had modems.

Even with the dramatic increase in network access, there is a disappointing report about availability in school classrooms. A study commissioned by the U.S. Department of Education's National Center for Educational Statistics (Heaviside et al., 1995) found that Internet connections are present in only 3% of public school classrooms, labs, and media centers. Further, 30% of public elementary schools have Internet access compared with 49% of secondary schools. However, 75% of public schools have access to some kind of computer network, e.g., a local area network (LAN) or a wide area network. After publication of the report, Vice President Gore urged telephone and cable companies to work with states and local communities to connect classrooms to the information highway by the year 2000.

Commercial suppliers of online services have increased their client base. The number of commercial service subscribers has grown to about 12.5 million users over the past decade, doubling in 1995. The number of World Wide Web users has increased eight-fold to 8 million in just the past year according to the International Data Corporation ("Exodus . . ." 1996, January 18). The number of people subscribing to more than one online service in 1995 has dropped significantly since 1991 when almost a third of the online users were multiple subscribers. *Business Week's* January 22, 1996 issue reports that

today 98% of the online users feel that they can do everything they want with just one service ("Exodus . . ." 1996, January 18).

With all of these developments in network activity, it comes as no surprise that the American Association of School Librarians (AASL) has established KidsConnect as a specialized service within their ICONnect technology initiative. KidsConnect is an Internet question answering service for students in K-12 schools. Students' questions are sent through the Internet to a central "switching" station at Syracuse University. Volunteer school library media specialists from all over the U.S. respond to students' questions, provide help, and send referrals. KidsConnect is modeled after the AskERIC electronic question-answering service sponsored by the Educational Resources Information Center (ERIC). AskERIC answers an average of 800 e-mail questions weekly from teachers and other educators.

In the January 26, 1996 issue of *The Chronicle of Higher Education*, several information technology officers credit the growth of the World Wide Web as stimulus for the growth of interest in using technology for teaching in the post-secondary classroom (DeLoughry, 1996). DeLoughry supports his contention with statements from college and university information technology officers. David Smallen, Director of Information Technology Services at Hamilton College, believes the web has attracted faculty because they can learn to use it without lengthy training, and do not have to worry about whether students are using an Apple Macintosh or IBM-compatible computer. The level of use may be only rudimentary, according to Polley McClure, Vice-President and Chief Information Officer at the University of Virginia. She suggests that only a few professors are using the equipment to its full potential. The World Wide Web sites that they develop are used to distribute course syllabi and other material that would normally be handed out in class. This rather simplistic use may be a necessary precursor to more sophisticated use later on.

As the magnitude of Internet use increases, it is inevitable that there are some skeptics. One Internet pioneer, Clifford Stoll, wrote *Silicon Snake Oil: Second Thoughts on the Information Highway* (1995) in which he publicly worries about the quality of time spent on the Internet. Neil Postman, a New York University professor of "media ecology" believes that computers and networks have not been scrutinized sufficiently (Postman, 1993). He notes that the decision to put computers in schools is seldom challenged, even though there is little

evidence to show that computers improve children's problem-solving skills. In a provocative paper about unplanned and unquestioning use of technology in education, Ely (1995) raises the question: "Technology is the Answer! But What Was the Question?"

Trend 3

Access to television resources in the school is almost universal.

Quality Education Data (1995a) reports that all but two percent of public schools in the United States have videotape recorders. About 75% of schools have cable service and 17% have satellite dishes. Sixty-one percent (61%) have videotape collections ranging from 50 to more than 500 titles.

In 1995, Cable in the Classroom, a public service initiative of the cable television industry, commissioned a study for the National Education Association, National Association of Secondary School Principals, National Association of Elementary School Principals, and the American Association of School Administrators (Malarkey-Taylor Associates, 1995). The stratified sample of 1,000 educators who had access to cable television programming represented classroom teachers, media coordinators and principals from elementary and secondary schools. In schools connected to cable, 58% of teachers used commercial-free Cable in the Classroom and 19% used Channel One, a free educational programming cable service to schools that carries commercials. Both services are free to education, and provide the necessary hook-ups and equipment to receive the programs. Cable in the Classroom serves about 70,000 schools, reaching over 80% of all public school students—more than 38 million students.

The study also determined that the most frequently used in-school television programs were supplied by the Public Broadcasting Service (PBS), the Discovery Channel, and the Cable News Network (CNN). Among the teachers and media coordinators who used Cable in the Classroom, 69% used PBS programs during the 1994-95 school year, 58% used the Discovery Channel, and 49% used CNN.

The growth of cable in schools has enjoyed a dramatic increase from 1989 when 6,165 schools were wired cable television use, to 1995 when 70,754 were wired for cable. The 1995 figure includes both public and private elementary and secondary schools; the 1989 number is only for public secondary schools (Nielsen Media Research, 1995).

The extent to which videotape is used is not available, but with 100% penetration of videotape recorders in public schools, it seems reasonable to expect that some cable programs are recorded and reused along with prerecorded videotapes included in a local or district collection. Video equipment used for live recording by students and teachers is another dimension of this trend. The number of articles in the literature about the use of television in teaching is an indication it is a frequently used tool. Perhaps the universality of its availability removes video equipment from educational technology status studies, since it has become an institutionalized medium rather than an innovation.

In higher education institutions, satellite "uplinks" and "downlinks" are being used more for short term staff development workshops than for teaching credit courses. One major player is the Institute for Academic Technology at the University of North Carolina at Chapel Hill whose satellite conferences on applications of information technology are used nationally. Teleconferences may lead to more specific uses of this technology in the teaching and learning process, but have not yet made any major impact except in cases like the National Technological University (NTU) which offers graduate and continuing education credit courses and degrees in engineering. Forty-five universities provide courses that are uplinked to NTU by satellite from the originating university, and then redistributed by the NTU satellite to the more than one hundred corporations and government agencies that subscribe to the service (Moore & Kearsley, 1996).

The National University Teleconference Network (NUTN) has more than 250 members from colleges, universities, community colleges and technical institutes. Most of the programming is professional staff development delivered by satellite. One-way video is complemented by two-way audio to ensure interaction. The typical program is a live video presentation to subscribing sites where a fee is paid to receive each program (Moore & Kearsley, 1996).

Trend 4

Advocacy for the use of educational technology has increased among policy groups.

Educational technology has not always been a significant player in education circles. There have been periods since the end of World War II when critics were strong in their opposition to "machines" in the classroom. The predecessor of educational technology, audiovisual education, was viewed suspiciously by teachers, school boards and administrators. With the passage of the National Defense Education Act in 1958, there were provisions for the acquisition and improved use of new educational media. As educational television began to be used in the late 1950s and early 1960s, new possibilities were envisioned. When the Public Broadcasting Service (PBS) came into existence and incorporated educational television, new applications such as *Sesame Street* began to take on a newfound respectability. The "third wave" brought about by computers and information technology has attracted additional supporters for technology applications in schools. This unusual support, at least in comparison with past attitudes, is facilitating the acceptance and use of educational technology in contemporary schools.

A survey of school priorities conducted by the Northwest Regional Laboratory for Research and Development discovered that educational technology is one of the six top issues in schools today. The others were: school improvement and restructuring, community engagement, the education profession, curriculum and instruction and student assessment (Northwest Report, 1995). In the past, there has never been an expressed priority related to educational technology. It appears that a new era has begun in American education.

One "bellwether" organization is the U.S. Department of Education. For the first time in history, there is an Office of Educational Technology in the Department. This Office has prepared a long-range national plan for the use of technology in education (Roberts, 1996). The development of this plan included extensive dialogues with educators, experts, representatives of state, local, and other federal government agencies, the private sector, and the public. The four major issues addressed in the plan are: infrastructure and financing,

professional development, content and software, and access and equity.

The federal government is working closely with state governments to develop and implement state plans for educational technology. Planning the Secretary's conference on educational technology involved a five-person team of educators, policy makers, and technology experts assembled by state school superintendents. The purpose of the conference was to develop strategies for the implementation of the long-range technology plan. This was the first major effort of its kind, and results should be monitored to measure progress.

Other federal agencies such as the Departments of Commerce, Agriculture, and Health and Human Services, and the National Science Foundation have all increased their spending on telecommunications programs designed for education and training. The National Telecommunications and Information Administration (NTIA) within the Department of Commerce manages a $26 million fund to assist educational institutions in developing and implementing innovative applications of computers and telecommunications in learning environments (Hezel, 1994).

In 1995, the Office of Educational Research and Improvement awarded five grants for Regional Technology Centers which will provide technical assistance to schools in their respective regions. The Centers are located in California, Illinois, Kansas, New York, North Carolina, and Oregon. The Centers are expected to serve multistate regions and build on existing resources and expertise in school districts, universities, research centers, federal laboratories, and the private sector. Centers will assist local efforts in building communication networks, training teachers, and integrating technology into the curriculum.

Grant programs help to support many specific initiatives in technology applications: (1) national challenge grants for technology in education; (2) star schools; (3) ready-to-learn television; and (4) special education technology media and materials. Within other programs, there are funding opportunities to incorporate educational technology applications into programs such as basic skills, science and mathematics, and vocational education.

At the annual convention of the National Education

Association, resolutions are presented, discussed and voted upon. During 1995, five resolutions focused on educational media and technology: (1) school libraries/media programs; (2) information literacy; (3) media; (4) technology in the classroom; and (5) telecommunications technology. Of special note are the statements of belief about technology in the classroom. These statements offer a dramatic reversal in attitudes held over the past 25 years.

The Association believes that—

a. Education employees should have access to necessary technology for managing and advancing instruction. Such technology must be compatible with, and on at least the same level as technology in general use outside education. Further, encouragement, time, and resources should be provided to experiment with and to research applications of technology in order to integrate technology into the curriculum.
b. Education employees, including representatives of the local association, must be involved in all aspects of technology utilization, including planning, materials selection, implementation, and evaluation. Individuals who teach classes over interactive communications networks should be given sufficient time to prepare for their classes. Additional preparation time should be granted to teachers using technology to enrich their regular programs. Further, classroom teachers and library/media specialists must have collaborative planning time to develop programs.
c. Training should be provided for education employees in the use of technologies and applications, the development of effective materials, and appropriate instructional strategies (National Education Association, 1995, p. 36).

Further sections in this unique statement of beliefs discuss preparing new teachers to use technology; awareness of social and economic impact of technology; understanding the copyright law; distance education; and evaluation of employees using technology.

The National Coalition for Education and Training (NCTET), through its Policy Committee, has focused on developing plans and monitoring activities related to the integration of technology and the information infrastructure into K-12 education at national and state levels. The purpose of this

group is to ensure that the "information highway" is easily and inexpensively accessible to schools for the electronic delivery of educational resources. The recommendations of NCTET have been adopted by several states and have become advocacy statements used with legislators and other government leaders (Cradler, 1995).

Trend 5

Educational technology is increasingly available in home and community settings.

Studies show an increased use of computers by students at home. In *The Condition of Education 1995* there are comparisons of students who use computers at school and at home; at school but not at home; at home but not at school, and at school or at home. Statistics were recorded for 1984, 1989, and 1993. The home setting is best revealed by comparing those who used computers at school *and* at home and at school *or* at home.

	At School and at Home	At School or at Home
1984	5.5 %	35.0%
1989	11.6%	53.7%
1993	18.8%	68.1%

Use *only* at home increased from 6.5% in 1984 to 9.1% in 1993. In all cases, student use of computers was up, with a substantial portion attributed to home use.

A study by the Software Publishers Association reported home sales of education-oriented CD-ROMs increased by 136% during the first half of 1995. The increase from the first half of 1994 was from $21.6 to $59.3 million (Heller Report, 1996 as cited in "CD-ROM software," 1996).

A study by EPIC-MRA, based in Lansing, Michigan, reports that nearly one half of all American households own a computer, and 17% of those who do not already own one plan to buy a computer in 1996. About 16% of those who own a computer subscribe to an online service. Persons most likely to own computers live in the Northwest, Pacific, and Northeastern parts of the United States ("Survey shows. ." *Educational Technology News*, 1995). A study by the American Learning Household Survey indicates that over 80% of home computer buyers cited children's education as the primary reason for the purchase. The survey also found that children's

use of the computer is shifting away from games, and more toward complex uses of the computer as an information access tool ("Education is key," 1996, February 18).

The public library is beginning to offer network access. Many libraries provide computers for personal use, and in some locations software is available for borrowing. A report from the St. Joseph (Missouri) Public Library indicates that there are 278 public library World Wide Web sites listed (St. Joseph's Public Library, 1995). The library itself is an active user of computers for management purposes: acquisitions, technical processing, database searching and circulation. Urban and suburban libraries are beginning to offer network access. The literature indicates many school library/media centers and university libraries already have network access.

The American Library Association (ALA) announced a partnership with Microsoft Corporation to launch Libraries Online ("ALA Microsoft Launch," 1996). Nine libraries have been named to participate in a $3 million effort to research and develop innovative approaches to extending information technology to underserved
populations. The Seattle Public Library will provide technical assistance to other libraries; the Pend Oreille County (Washington) Library will serve 9,100 people in a rural area that includes the Kalispell Indian Reservation; Charlotte-Mecklenberg County (North Carolina) Public Library will expand current local networks to rural and disadvantaged urban areas; Tucson-Pima (Arizona) Public Library will coordinate local school district technology efforts with community services; the Mississippi Library Commission will support recently approved funding to connect every county library to the Internet; the South Dakota State Library will expand the state server network to rural and disadvantaged communities including Native American reservations; Baltimore (Maryland) County Public Library will establish a Family Learning Center in a branch that serves a densely populated and disadvantaged community; and the Los Angeles Public Library will create two "virtual electronic libraries" to serve economically disadvantaged communities within the city.

Karen Schneider (1996) sees a trend in the creation and use of library and community networks. In a recent article in *American Libraries*, she provided examples of public library and community networks that are cooperating to provide information and communication opportunities to individuals

in their service areas. The locations of these efforts are Seattle (Washington) Public Library and the Seattle Community Network; Montgomery-Floyd (Virginia) Regional Library and the Blacksburg Electronic Village; Allen County (Indiana) Public Library and Infonet in Fort Wayne; and the Flint (Michigan) Public library with the Greater Flint Community Networking Initiative. Schneider says that "Increasingly, librarians have been using new technologies to develop or collaborate on community networks' free or low-cost electronic community information systems, usually Internet based, that can provide a variety of services . . . these community networks are often created in collaboration with other local agencies and advocacy groups, weaving libraries more tightly into the community organism" (p. 96).

Trend 6

New delivery systems for educational technology applications have grown in geometric proportions.

Revolutionary developments in technology have replaced the evolutionary pace of previous years. These developments, often referred to as *delivery systems*, are focused on hardware (equipment), software (materials), communications media (transmission), and strategies (techniques for use). The delivery system, as used here, is essentially a combination of all four elements.

The most dramatic and obvious developments are in the area of new *hardware*. Products are more visible and pervasive than transmission or techniques. Most new delivery systems *begin* with hardware but do not end there. For example, CD-ROM hardware must be combined with CD-ROM *software* to have any practical application. CD-ROM is one of the most dramatic of the newer developments. The number of public schools using CD-ROM has increased nearly 250% since 1988. In the most recent year for which data are available (1993-94), the number of schools using CD-ROM increased by 80%. CD-ROM drives are used in 37% of public schools, accounting for more than 15 million students in the United States (Hayes, 1995).

The growth of CD-ROM is probably influenced by several factors. More personal computers have integrated CD-ROM drives. More multimedia software is delivered on CD-ROM discs. In both community and school settings, CD-ROM software is providing learning resources at a lower cost than printed publications. Encyclopedias and reference books are good examples. Not only are production costs lower (and hence a lower sales price), but it is possible to release up-to-date supplements in a timely fashion at less cost. Public libraries and school library media centers are especially active in the acquisition and use of CD-ROM software.

A close relative of the CD-ROM in the laser disc family is the videodisc, which requires both *hardware* and *software* for delivery of information. With not as dramatic a growth as its smaller cousin, the CD-ROM, the videodisc reached 28% of public schools in 1994-95 (QED, 1995). This is an increase of 18% from 1991-92. The software associated with videodiscs is

usually integrated with computers to allow interactive educational programs with audio and video capabilities. Filmed sequences can be stored less expensively on videodiscs than on computer discs. Since 1991, there has been a growth rate of 160% in videodisc use in public schools. More than 20% of public schools are using laser disc players with interactive videodisc software for instruction. This percentage represents more than 12 million public school students (Hayes, 1995).

One of the newest *communication mediums* is the satellite dish. It can be used to receive (download) or send (upload) information. Quality Education Data reports that 10% of elementary schools, 22% of middle/junior high schools and 37% of high schools had satellite dishes in 1994-95. This is an increase from 1%, 1%, and 4% respectively since 1991-92 (QED, 1995a).

Another communication medium is the Local Area Network (LAN). Local area networks connect computing equipment within one building, wide area networks (WANs) connect computing equipment from one building to another, and larger networks extend to regional, state, national and international service areas. Access to networks may be provided through commercial or non-commercial sources. Commercial networks such as America Online, Compuserve and Prodigy operate as a fee-based service. Access can also be obtained through university and governmental networks. The Internet is one of the most frequently used networks. The original non-commercial nature of the Internet seems to be giving way to more commercial applications.

Networks are used for a variety of purposes in education. E-mail, FTP, and listservs constitute much of the use. The World Wide Web has quickly surpassed "gopher" as an information source. The opportunity to create a personal home page exists for anyone, and the number of web sites has grown dramatically with little formal organization. A few groups have attempted to index some of the web sites as a service to users. Late in 1994, Yahoo was established as one of the first web search engines. Other search engines include, Lycos and NetSearch. Several organizations e.g. Point Communications, Magellan, and Global Network Navigator publish critical reviews and rankings of web sites.

The actual number of web sites is unknown. Miller (1995) estimated that there were 10 million electronic web documents.

Growth is measured in millions each quarter. In the late 1990s, personal (or institutional) web pages have become a status symbol.

Distance education was a frequent topic in the content analysis of the 1995 literature. While the emphasis is often on the delivery system, i.e., the means of getting instruction to the learner, distance education as described here is a strategy for providing instruction to learners who are geographically separate from their teachers. Much of distance education is delivered by contemporary hardware, software, and transmission systems, but it is the *design* of the software, the *organization* of the delivery, and the built-in *interaction* and *feedback* that make it a unique application of technology in education. Most frequently, delivery is by computers, computer networks, and by cable and satellite transmissions. A simpler technology, telephone lines are often used for "live" audio interactions, and for FAX communication between students and teachers. Distance education is active at all levels. On the K-12 level, senior high schools are the most frequent users. At the post-secondary level, adult learners predominate. These adults may be seeking course credit, a college degree, professional updating, or all three.

Some of the most active distance education efforts are at state or regional levels. The client is almost always the individual learner in the local school. From its studios in Texas, the TI-IN service broadcasts courses to high schools in more than 1,000 school districts in 29 states. The Massachusetts Corporation for Educational Telecommunications links 1,300 schools in the state, and more than 1,000 schools in surrounding states, as well as 22 colleges in the New England area. Kentucky installed satellite downlinks at every school in the state in 1988, and is fully operational today. Other television-based distance education programs exist in Alaska, Georgia, Indiana, Nebraska, Virginia and Utah (Moore & Kearsley, 1996). The Council for Chief State School Officers (1995) made a series of recommendations regarding the use of telecommunications in achieving the National Education goals.

Computer networks are also used for distance education. While not as well established as some of the television-based programs, computer networks are often used for e-mail communication between student and teacher and among students. Computer networks are also used as resources, much the same as libraries, where students can find textual material

and other resources for learning. Not many complete computer network courses exist as yet for K-12 students, but there are children's network resources such as Kidsnet, Kids Network, NASA Spacelink, and FrEdMail for electronic communication. Higher education is a little further along with the New York Institute of Technology, University of Phoenix, and the New School for Social Research offering complete degree programs via computer conferencing (Moore & Kearsley, 1996).

Trend 7

There is a new insistence that teachers must become technologically literate.

One of the early overviews of the use of technology in education, especially oriented toward distance education, was *Linking for Learning* (U.S. Congress, Office of Technology Assessment, 1989). It identified the need for teacher training in the use of technology:

> The critical role of teachers in effective learning means that all must have training, preparation, and institutional support to successfully teach with technology....Few teachers have had either teacher education or field experiences that enable them to be effective distant teachers or successfully use technology in their own classroom (pp. 10-11).

It does not appear from the content analysis of the literature that much progress has been made since that publication was released. An article in *Investor's Business Daily* quotes a *Fortune* magazine article which reports "... last year businesses spent well over $2 billion training their employees on the use of technology, but 90% of the teachers in America reported that they were 100% self-taught" (p. A8). This statement was backed up by California's Superintendent of Public Instruction who said that schools are still woefully behind industry in preparing their employees to use technology ("Teachers still lag . . ."*Edupage*, September 28, 1995).

The National Education Goals (1995) reports that despite the many changes in educational technology and student assessment strategies occurring in 1994, only half of all teachers reported any professional development opportunities in those areas. They were more likely to have participated in inservice courses on methods of teaching a subject matter field than in the use of educational technology.

Teacher education in the application of technology in the classroom is still a high priority need. One sign of increasing interest and action in this area is the publication of a new periodical, *Journal of Technology and Teacher Education*, published by the Association for the Advancement of Computing in

Education. The authors are teachers and teacher educators who are actively participating in the movement toward technological "literacy" for themselves and their students.

Higher education faculty are not immune from updating and upgrading skills in the use of technology in their classrooms. Kenneth C. Green (1996) summarizes the current status of technology in many college and universities:

> "...the presence of technology in the learning environment is increasingly common: an e-mail address on a course syllabus; electronic mail as a supplement to office hours; class sessions held in computer labs; desktop computers in faculty offices; commercial software and simulations as part of the resources provided by textbook publishers; and course assignments that send students to the World Wide Web (WWW) sites in search of information resources . . ." (pp. 24-28).

But there are less optimistic viewpoints from some post-secondary faculty. The January 26, 1996 issue of *The Chronicle of Higher Education* reported a new policy paper from the American Federation of Teachers (AFT) calling on its members "...to oppose courses taught on the Internet, through videoconferencing, or with other technologies unless they meet faculty members standards of quality." Further, AFT "... urged its members to seek restrictions on the number of credits for distance education that students can receive, and to oppose undergraduate programs that are taught entirely with technology." The report raises questions that faculty should pose prior to adoption of technology, and provides guidelines for using a variety of technological applications in higher education settings (Blumenstyk, 1996, p. A20).

Trend 8

Educational technology is perceived as a major vehicle in the movement toward education reform.

The movement for restructuring education in schools across the United States has generated proposals and plans for reform of the entire educational system. Virtually every proposal or plan includes educational technology as one of the major vehicles for implementing change. One of the key documents published by the Office of Educational Research and Improvement of the U.S. Department of Education is *Using Technology to Support Education Reform* (Means, et al., 1993). This publication spells out the roles and functions of technology in the education reform process. The authors cite tutorial presentations, exploratory investigations, tool applications (word processing, spreadsheets, database management, etc.), and communication uses "that allow students and teachers to send and receive messages and information to one another through networks or other technologies" (p. 11). These applications are even more prevalent in 1995, just two years after the publication of this important work. The conclusion by the authors in 1993 was that "...support for the use of technology to promote fundamental school reform appears to be reaching a new high" (p. 1). In 1995, the appearance is even more of a reality.

The process for reform and school restructuring is presented by Gillman (1989) in a report based on his doctoral dissertation. Gillman's primary recommendation focuses on the development of an educational technology plan. This plan becomes the framework for strategic planning in which educational technology plays a central role. The recommendations for design and implementation made by Gillman are emerging in state plans for educational technology being created with participation by local school districts. One impetus for developing such plans is the promise of financial support to those schools and districts that have developed and presented plans to state educational agencies for approval. The establishment of the Regional Technology Centers in 1995 by the U.S. Department of Education is a move to assist states with technology planning for purposes of reforming and restructuring schools. State education agencies have been strongly urged to create state plans for educational technology

applications in the schools. In 1995, almost every state had completed, or was in the process of completing, an educational technology plan (Hezel, 1994). Some plans were part of a larger education reform plan, and others were separate. In either case, the vital role of technology is evident in the plans. These plans are the basis for allocating federal funds for technology in the states.

The Council of Chief State School Officers (CCSSO) published a major report (CCSSO, 1995) supported by the National Telecommunications and Information Administration (NTIA) that assessed the relationship of distance learning to the nation's educational needs, especially in achieving the National Education Goals. The recommendations made by the combined authority of these two agencies, CCSSO as representative of all state education agencies in the United States and NTIA as lead federal agency in promoting telecommunications, reflect new and powerful support of educational technology at the national and state levels.

In a move to provide technical assistance to the states, six regional educational technology consortia were established in 1995: NetTech at the City University of New York; the North Central Regional Technology Consortium in Oak Brook, Illinois; the Center for Language, Minority Education & Research at California State University, Long Beach; the South Central Regional Technology Consortium at the University of Kansas; SERVE (Southeastern Regional Visions in Education) in Greensboro, North Carolina; and the Regional Technology Consortium at the Northwest Regional Educational Laboratory in Portland, Oregon.

These consortia provide advice to states and local districts concerning technology and training for educators in order to promote the effective implementation of technology. The intent is to build on existing resources and expertise in school districts, universities, research centers, federal education laboratories, and the private sector to help local efforts to build telecommunications networks, train teachers, and integrate technology into the curriculum. The awards for 1995 were approximately $10 million.

In an overview of educational telecommunications development as of 1994, Richard Hezel reports that "... school 'restructuring' and educational reform are influencing the adoption and use of telecommunications. The recognition that

the instructional process must evolve from teacher-centered to student-centered learning has evoked imaginative ideas about learning activities and how to construct those activities. Rather than through activities that revolve around teacher-delivery, instruction is increasingly delivered through machines. Under this model, teachers become essential managers and guides for student-centered learning" (Hezel, 1994). Hezel has tracked the development of telecommunications in the United States since 1987. This is the fifth edition of this comprehensive study.

While it is clear that technology is at the heart of many reform and restructuring plans, there is a danger that the hardware definition of technology may prevail. The acquisition of computers, videotape recorders, and CD-ROMs may be an observable sign of progress, but it is the creative application and use of such tools that introduce new approaches to learning. A useful definition of instructional technology is:

> ". . . the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning" (Seels & Richey, 1994, p. 1). With this definition of technology in mind, the probability of school reform and restructuring is enhanced.

Trends are best determined by observing specific actions over time. This monograph, as a continuation of the 1988, 1989, and 1992 analyses, is able to provide a long range view of trends in educational technology. As a result, a higher confidence level can be established, and the review of trends allows a long range summary.

The one outstanding finding is that trends have not changed significantly over the seven years. When one reviews the categories of the content analysis, there is very little movement in rank order. Instructional processes have remained in first position over the years (See Table 1). Technological developments have been in second or third place since 1988. Services has been in sixth place for three of the four times, and the society and culture category has been in seventh or eighth place during all years of the study. Other categories (management, research and theory, and the field) have changed positions slightly. This consistency contributes to confirmation of the trends.

Analysis of Trends 1988-1995

Trend analysis often uses statistical data to back up the qualitative statements. This study of trends is no different. Most of the trends in the 1995 study use statistical data to justify the statements. By counting the number of computers in schools and looking at the student computer ratio, it is easy to infer the potential impact on K-12 education. What such data do not indicate is a description of the actual use of the computers. What difference are they making in learning? Likewise, the same logic applies to networks, television, and numbers of new delivery systems in schools. It would be easy to say that "educational technology=hardware/software" if only numbers were considered. When one reads about dramatic increases in the number of computers in the home, and CD-ROMs in school media centers, it is easy to conclude that availability is equal to creative and appropriate use by students for the purpose of learning in subject matter fields. Actual observations in the schools might diminish the effect of this extrapolation.

There is an undercurrent in the literature that appears to equate educational technology with *information technology*. As the use of computers, networks, and telecommunications increases dramatically, new advocates are created, and replace, to some extent, professionals who have been prepared to serve the field from a broader perspective—that is, from the design and development point-of-view. Most educational technologists insist that their work emphasizes the *design and development* of instruction for the improvement of learning, and *not* the application of hardware and software. However, *the trends seem to reflect a hardware emphasis*. When the two top ranking categories in the content analysis process reflect both design (instructional processes) and hardware/software (technological developments) it should become obvious that *both* are important, and *both* are related and often necessary to the process called instructional design and development. The emergence of a new definition for "educational technologist" is worrisome to some of the more established professionals. This potential conflict is not evident in the current analysis of trends, but it is an undercurrent that may emerge in the future. The better long range solution would be for professional educational technologists to become more adept with the newer

technologies, and for the latter day practitioners to gain new skills in design, development and evaluation. There seems to be room for both "camps" but adjustments must be made on both sides.

Some of the "soft" trends are less quantitative, but nonetheless important. The increase of advocacy voices, evident in the 1995 trends, was not as visible in the earlier studies. Educational technology is becoming an "acceptable" term in the higher echelons of education hierarchy. Public statements offer evidence of this fact. Likewise, the role of educational technology in education reform and restructuring is an integral part of the plan for each. On the cynical side, one might say that hardware and software offer visible evidence that something is happening in a school. There is not much "hard" evidence that there is an improvement in learning in settings where such equipment has been added. However, optimism prevails and schools continue to purchase hardware and software as symbols of progress and change. More obvious is the increasing use of distance education to provide resources that are not available in a local school. Distance education requires a means or medium to make it work. Satellite and cable television along with computers and networks provide the means. It is difficult to offer distance education without the hardware and software. Such installations are increasing, and seem to make more sense than simply adding equipment to the school's computer laboratory. The impact on learning is still unclear.

Inherent in many of the emerging trends in educational technology is the increasing wish for teacher education and staff development programs that will help teachers and other educators become more proficient with today's technology. School administrators, boards of education, and teachers themselves realize that the development of educational technology competencies are absolutely essential for survival as the 21st century approaches. Professional education organizations that were silent about the use of technology, or even opposed to its use, are now speaking out in its favor, but with carefully phrased statements that protect their constituents. These statements do not reach the educational technology literature as much as the publications of the teachers' associations and other policy groups. Therefore, the content analysis of educational technology trends has to extend its reach to related literature, not just the publications directly related to the field.

Trends can be used to determine future directions if carefully applied. An organization that does not have its mission, goals and objectives clearly stated will not find that local adoption of trends will advance the organization. When trends fit the purpose and desired outcomes of an organization, they can be applied and adapted to fit local circumstances. The guideline should be: "Apply with care."

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Methodology Used in This Study

The approach to this study is described in the Introduction. It spells out the content sources and summarizes the findings. General comments are made about content analysis and its specific application in this study. The purpose of this section is for the analysts to reflect upon the methodology. It was written by Paul Blair, Paula Lichvar and Deborah Tyksinski.

Justification

The justification for using content analysis in this study lies in the uniqueness of the methodology. Researchers have at their disposal a wide range of methodologies from which to choose. In this study, the assessment of trends in educational technology is the primary goal. The researcher is not concerned with finding the answer to a distinct problem, performing a comparative analysis, or looking at cause and effect relationships. The central reason for using content analysis in this study is that the words used within the educational technology literature can be classified into a number of categories. The words used within each category can also be classified. Therefore, certain trends in educational technology will emerge as measured by the number of items in the categories. According to Holsti (1969), content analysis usually focuses on the attributes of messages and not on the intentions of the sender or the effect on the receiver. As a knowledge gathering method, it specializes in symbolic events, and is not a method for determining meaning of individual messages. The content analyst aims to identify social trends arising out of the content of data over a specified period of time.

There are four distinctive characteristics that make content analysis a distinctive method of inquiry (Krippendorff, 1980), and the reason it was chosen over other methods for this study. First, content analysis as compared to other methods, such as surveys, experiments, case studies, questionnaires, etc. is an unobtrusive research technique. The content analyst, when retrieving information, does not affect the context from which the data is gathered. The receiver does not know that the message is being analyzed. As a result the measurement process does not influence the study. Second, content analysis accepts unstructured data. In this study there was no prior

manipulation of the data received. The content analyst used the information based on its source and not its format. The study used the journals and conference materials as research materials previously listed. Third, content analysis is context sensitive, and thereby able to process symbolic forms. Cultural indicators are viewed as reliable data, and may be used to assess relationships in change, i.e. the change in trends in educational technology. The research design of a content analysis study must be case sensitive in order to achieve validity. In other research methods, the symbolic meaning of the message is often dissociated from the context. In this study, the data is analyzed in terms of the environment in which it was found, i.e. conferences and journals in educational technology. Fourth, content analysis can cope with large volumes of data. It is limited only by the boundaries which the content analyst sets. At the beginning of the study, the content analyst could have made the decision to analyze three times the data. In methods such as surveys, or experiments, the research is bound by the data limitations set by the nature of the study.

Content analysis is an accepted form of scientific inquiry. The four justifications for utilizing content analysis as described above do not mean it is any more or less a valid or reliable method than other forms of inquiry. It is what works best as defined for this project.

The limitations of other research gathering options such as using a panel of experts or a written survey far outweigh the limitations of the content analysis approach. Experts, regardless of their knowledge, may not be objective in terms of how they view emerging trends. Their experiences, the journals they read, the conferences they attend, and the part of the country in which they reside may have a effect on their personal views. The same limitations hold true for written surveys, not to mention the cost factor involved. By performing a content analysis on the journals and conferences as done in this study, both the sample size and the diversity of contributors were increased.

Content analysis provided this study with the telescopic view it needed to analyze various sources of information nationwide.

Limitations

What makes content analysis a feasible method for the review

and comparison of large amounts of written communication also fixes its limitations. The validity of the study is enhanced because the reviewers were able to use a few broad categories to compare variations in content in a general way. At the same time, the reliability and richness of the meaning of any single document is reduced. Subtle observations and emerging changes are sacrificed for the sake of consistency in the identification of obvious trends. Comprehension emerges by generalizing the observations of the reviewers.

Perhaps the greatest limitation of the methodology is the screening process. Reviewers act as human filters to redefine the essence of the original communication within the confines of the pre-determined categories. The original meaning is interpreted by the reviewer who then translates it into the closest available meaning within categories. When faced with great volumes of text to interpret and categorize, the original meaning of the communication can become distorted in this process. The reviewer must consciously choose the same interpretation of the codes for each document or stand to lose meaning to the subtleties of the process. Was the reviewed article about the "method of evaluation" or was it an "evaluation of a product or process"? The final determination requires continual alertness on the part of the reviewer.

The meanings of words change with time, but none so swiftly as the language of technology. Though the same codes must be used from year to year to insure consistency, the researcher is required to examine closely the meaning of the codes each year to ensure that they symbolize the same idea over time. How do you account for new terminology and new technologies? Do you add new codes? If so, how do they impact the interpretation of technologies? If you add new codes, how do they impact the interpretation of the trends. Where possible, this situation is handled by developing new subcategories within the general category. Skillful attention to the details of the methodology allows it to subtly evolve along with its subject matter.

There are several limitations specific to the method used in this study:

Over 1,400 articles were reviewed by one of the two teams of reviewers. Each team consisted of two graduate students with a reasonable understanding of the subject matter. While each team attempted to apply consistent interpretation of the codes,

there was bound to be some variability between the teams. The project director (author) served as the third reviewer for each article and worked to maintain consistency between the teams.

The use of the ERIC Clearinghouse materials made this project feasible, but also lent a degree of bias to the findings. It is possible that scholars of a particular bias are likely to submit their work to ERIC, while others within the same field are not. Likewise, authors of journal articles and conference presentations could carry the same type of bias. The use of British sources could skew the data, but could also help to balance the findings from a more global viewpoint. What then can be learned from this process?

Lessons Learned

The following are the lessons learned as a result of the teams' effort in this project:

1. Data validity is extremely important. The best approach is by 'triangulation of analysis.' Validity was reached in this study by having more than one individual review and categorize the same data. If consensus was not reached, the categories were reviewed to ensure that they were being applied correctly. A third content analyst then reviewed and categorized the data. By using 'triangulation of analysis' in content analysis, validity is kept intact.

2. A content analysis variable is valid only to the extent that it measures the construct the content analyst intends it to measure. Therefore, the categories must be explicitly defined, and each analyst must understand how each category is to be applied. This study revealed that any time a consensus was not evident, it was because one or both of the analysts had failed to properly apply the correct meaning of the category.

3. Classification procedures must be reliable and consistent over time to show fluctuations or changes in trends. However, if new trends are viewed in the process, newer categories might need to be entered. Trends in educational technology are changing significantly from year to year just based on the accessibility of the knowledge base. Different people should code the same text in the same way.

Classification by multiple human analysts permits the quantitative assessment of achieved reliability. Reproducibility or intercoder reliability is important in that more than one analyst is used to code the same text. This is important in order to decrease ambiguous coding instructions, cognitive differences among the analysts, and random recording errors (Weber, 1990).

4. Categories are useless if they are too general, and may not reflect true trends if they are too specific. Therefore, the categories need to be validated even before the content analysis begins.

5. The specific information sources used as a basis for content analysis may not truly reflect trends unless they are carefully chosen and reflect a wide enough audience.

6. Because the individuals in the content analysis team will not be the same from study to study, it is important to pass down lessons learned, and probable changes that may need to be addressed before the commencement of another study.

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Appendix A

Content Analysis Recording Sheet

Journal
Issue_____Issue_____

Category

Article title	1st Choice	2nd Choice

Appendix B

Recording Units: **Trends and Issues Study**

TRENDS

The Field

- History
- Status
- Future
- Ethics
- Legal Aspects
- The Standards

Personnel

- Roles/Responsibilities
- Leadership
- Professional Education

Management

- Organization
- Logistics/Operations
- Procedures/Policies
- Facilities
- Finances/Budget
- Planning Processes
- Diffusion/Dissemination
- Implementation

Technical Developments

- Computer Related
- Telecommunications
- Video
- Audio
- Multimedia

Instructional Processes/Services

- Distance Education
- Simulations/Games
- Problem Solving
- Interactive Video
- AI/Expert Systems
- Design and Development
  - Needs Assessment
  - Task Analysis
  - Indiv. Differences/Learner Characteristics
  - Message Design
  - Course Development
  - Product Development
- Motivational Strategies
- Evaluation
  - Product Evaluation
  - Process Evaluation
  - Cost-effectiveness Evaluation
  - Formative Evaluation

Services

- Curriculum Support
- Skills Instruction
- Information Services

Research and Theory

- Research Methodologies
- Theory and Model Construction/Application

Society and Culture

Appendix C

Definitions of Recording Units

The Field

History - previous developments that have influenced the current status of the field.

Status - any item that reports the current state of educational technology professionals or activities in which they are involved.

Future - those items that indicate future developments within the field.

Ethics - professional activities that relate to values or morality in professional decision-making.

Legal Aspects - matters of law pertaining to the field.

The Standards - refers to the AASL/AECT publication, *Information Power*, which spells out standards for school library media programs; also, establishment of standards for the profession.

Personnel

Roles/ Responsibilities - professional activities of educational technologists and their relationship to colleagues and to an organization.

Leadership - recognition of qualities or performance that provides evidence of advancing the field.

Professional Education - preservice or inservice preparation of educational technologists; curriculum; certification; training or evaluation of

competencies.

Management

Organization - administrative arrangements for operating an educational technology program within an organization.

Logistics/ Operations- providing the right material and equipment to the right place at the right time.

Facilities - physical plant or instructional space including classrooms, media centers, library study spaces and equipment associated with such spaces.

Finance/Budget - anything pertaining to money, funding, or finance and its use in an educational technology context.

Planning Processes - program planning at any level for current or future operations.

Diffusion/ Dissemination - transfer of ideas and processes from one source to another; the communication of an innovative idea or procedure; the spreading of information to sources that are perceived to be new.

Implementation - the adoption and actual use of an idea or procedure by an individual or an organization.

Technical Developments

Computer-Related - items that focus on the computer as an instructional delivery system or use the computer in conjunction with other media or methods.

Telecommunications - the use of communications technology for transmitting information; includes

	television, satellites, cable, ITFS, teleconferencing, telelecturing, and point-to-point transmission with two-way communication.
Video -	any item about moving visual images, usually captured on videotape or motion picture film, and distributed by videocassettes or film on reels.
Audio -	radio or sound recordings including interactive radio for instruction, language laboratories and all types of audio delivery media; CDs, audio cassettes, disc recordings.
Multimedia -	the presentation of more than one visual and/or audiovisual stimuli controlled by a computer or other device.

Instructional Processes and Services

Distance Education -	teaching and learning in settings where the instructor and learner are removed from each other in time and space; includes telecourses, correspondence study, computer-based teaching/learning as part of a comprehensive system of education or training that culminates in completion of an assignment, course, curriculum or training program.
Simulations/ Games -	the design and conduct of instructional games in which individuals play roles of people who are located in simulated settings.
Problem Solving -	the process of teaching and learning whereby the individual is confronted with a simulated or real dilemma, problem, or issue that requires resolution.

Interactive Learning - the design and use of a process that requires learner response to visual stimuli usually delivered by a computer and laser disc; this item focuses on *process*, not on the equipment.

Artificial Intelligence/ Expert Systems - the design and use of computer-based software that emulates human performance; the emphasis is on the software.

Needs Assessment - the procedure that precedes the actual design or instruction usually focused on the learner.

Task Analysis - the procedure that attempts to simplify complex activities by determining the discrete steps involved in proper order.

Individual Differences/ Learner Characteristics - analysis of the special characteristics of individuals who will use materials that will be designed.

Message Design - the sequence and configuration of text, images, and sound in the instructional process regardless of medium; uses principles of visual design as well as psychological principles determined by research and experience.

Course Development - at a macro level, the design process that considers the entire course as the unit of development.

Product Development - the process of designing, producing, and evaluating a specific item of instruction in any medium; two subsets that appear frequently in the literature: (1) *courseware design* which is a special case of product development related to computer-based instruction; and (2)

hypermedia, a special case related to the heirarchically developed instructional materials that are delivered by computer and peripheral equipment such as a videodisc player.

Motivational Strategies - those designated procedures or activities that are intended to stimulate and maintain interest in an instructional event.

Product Evaluation - assessing the worth of an instructional material or package of resources.

Process Evaluation - assessing the worth of a procedure.

Cost-effectiveness - determining value in specific financial terms for the purpose of providing data for decision-making.

Formative Evaluation - the procedure that precedes the actual use of an instructional material or process.

Services

Curriculum Support - those items related to the use of media and technology in specific curriculum areas at any level; the focus should be more on the media and methods than on the content but content is essential in this category.

Skills Instruction - the teaching of psychomotor skills including procedures and media that are specific to skill acquisition.

Information Services - aspects of educational technology

resources that provide unique information about the field to users; services that provide awareness of and access to educational technology resources specifically intended for instructional use.

Research and Theory

Research Methodologies - those items that focus on the research methodology, not on the research findings.

Theory and Model Construction/ Application - theory or theoretically-based analysis including items on instructional models or evaluation models that provide hypothetical generalizations that can be applied in a variety of settings.

Society and Culture

the impact or potential impact of media and technology on learners; these items are the "big" questions about the value (and sometimes the moral dimensions) of technology in society.

Note to Raters: Many of the items reviewed could be placed in several categories. Try to find the *dominant* theme and a secondary theme. Ask "Where is the author placing emphasis?" Record the first *and* second choice on the Content Analysis Recording Sheet. Discussions will be held on each item reviewed.

Appendix D

Trends by Topic and Source

	Journals	Dissertations	Conferences	RIE	Total
The Field					
History	0	0	0	3	3
Status	7	1	10	29	47
Future	3	0	9	6	18
Ethics	1	0	1	0	2
Legal Aspects	0	0	8	13	21
The Standards	0	0	3	1	4
Personnel					
Roles/Responsibilities	1	0	9	0	10
Leadership	1	0	0	-	1
Professional Education	2	0	24	2	28
Management					
Organization	3	0	6	7	16
Logistics/Operations	0	0	4	0	4
Procedure/Policies	4	0	6	1	11
Facilities	1	0	9	0	10
Finances/Budget	1	0	1	3	5
Planning Processes	3	0	12	11	26
Diffusion/Dissemination	3	3	21	17	44
Implementation	8	4	35	15	62
Technical Development					
Computer Related	3	1	37	53	94

	Journals	Dissertations	Conferences	RIE	Total
Telecommunications	9	1	21	28	59
Video	1	0	8	5	14
Audio	1	0	6	3	10
Multimedia	6	0	4	13	23
Instructional Processes/Services					
Distance Education	6	6	30	25	67
Simulations/Games	2	1	5	0	8
Problem Solving	1	3	5	4	13
Interactive Video	1	0	8	3	12
AI/Expert Systems	5	0	1	2	8
Design and Development	2	5	10	4	21
Needs Assessment	0	0	6	5	11
Task Analysis	0	0	4	2	6
Indiv. Differences/ Learner Characteristics	6	1	4	9	20
Message Design	6	3	12	24	45
Course Development	6	0	19	5	30
Product Development	11	2	38	14	65
Motivational Strategies	2	0	4	6	12
Evaluation					
Product Evaluation	2	0	11	24	37
Process Evaluation	5	1	12	33	51
Cost-effectiveness Evaluation	0	0	6	1	7
Formative Evaluation	1	2	2	3	8

	Journals	Dissertations	Conferences	RIE	Total
Services					
Curriculum Support	3	0	10	11	24
Skills Instruction	2	0	9	17	28
Information Services	3	0	11	21	35
Research and Theory					
Research Methodologies	5	-	4	7	16
Theory and Model Construction/Application	28	3	52	19	102
Society and Culture	8	0	18	11	37

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